here to select priority areas are pertinent to biological or landform values only. Criteria relating to landscape, recreational, cultural or historical, and soil and water conservation values may identify sites significant in one or more of those respects.

MAPS

The topographic maps of the RAPs presented in the report are based on 2003 digital aerial photographs held by the Bay of Plenty Regional Council and provide relatively accurate representation of the RAP boundaries. The sketch maps were prepared in 1994 and have been retained in this report to show the location and extent of vegetation types, but the maps were not drawn to scale. Where the boundaries on the two maps differ, the topographic map overrides the sketch map RAP boundaries. Some of the sketch maps in this report were updated in 2006 immediately prior to publication and thus have a slightly different appearance from the maps prepared in 1994.

4. Results

SURVEY DATA

Field survey data cards are held at the Bay of Plenty Conservancy Office, Department of Conservation, Rotorua.

VEGETATION PATTERN

Indigenous vegetation

Present day indigenous vegetation is predominantly forest with a few scattered wetlands. Sand-dune vegetation is present along the 16 km coastal strip. Most remaining forest has been logged. Detailed vegetation types are identified for each RAP. These accurately portray the vegetation types present in each RAP. They particularly reflect the considerable variation in secondary vegetation types, which are present. From these, sixty broad vegetation types and habitats were identified for the ecological district. These are listed in Table 4 and described in Appendix 2. These are generalisations of the types present and do not correspond exactly with the vegetation type names used in the RAP descriptions. The RAPs that each broad vegetation type occurs in are identified in Appendix 2.

TABLE 4. VEGETATION AND HABITAT TYPES

Forest
* Hard beech forest
* Hard beech-pohutukawa forest
* Hard beech-tanekaha-tawa forest
* Kahikatea-maire tawake forest
* Kamahi forest
* Kanuka forest
* (Kauri)/podocarps-broad leaved species
* Kauri (rickers)/tanekaha-tawari forest
* Kauri rickers/tawari forest
* Mangeao forest
* (Miro)/tawa-kamahi-tawari forest
* (Northern rata)-(rimu)/tawa-kohekohe forest
* (Northern rata)/tawa-kohekohe forest
* Pohutukawa forest and treeland
* Pohutukawa-kanuka forest
* Pole podocarp forest
* Rewarewa/broadleaved species-treefern forest

* Rewarewa / kamahi forest
* Rewarewa / kamahi-kohekohe-mangeao forest
* Rewarewa / kanuka forest
* (Rimu)-(miro)-tawa-kamahi-tawari forest
* (Rimu)-(miro)-(tanekaha) / tawa-hinau-rewarewa-kamahi-tawari- tawheowheo forest
* (Rimu)-(northern rata) / tawa-kamahi-rewarewa-mangeao forest
* Rimu-red beech / tawa-kamahi-tawari-hard beech-silver beech forest
* Rimu / tawari-kamahi / *Gahnia xanthocarpa* forest
* (Rimu) / tawari-wheki-maire tawake forest
* Tanekaha forest
* Tawa forest
* Tawa-kamahi-tawari-hard beech-silver beech forest
* Tawa-rewarewa forest
* Tawa-rewarewa-pukatea-kohekohe forest
* Tawari forest
* Tawari-tawheowheo forest
* Heavily logged rimu/tawa forest

Secondary scrub, shrubland and fernland

* Mamaku treefernland
* Secondary scrub, shrubland and fernland

Sand dune vegetation

* Dune hollow wetlands
* *Spinifex* sandfield and grassland
* *Ficinia nodosa* / *Muehlenbeckia complexa* vineland and sedgeland

Wetland vegetation

* *Myriophyllum pedunculatum* subsp. *novae-zelandiae* herbfield
* Raupo reedland
* *Baumea teretifolia* sedgeland
* Sedge-grass-reed wetland associations
* (Manuka)-(grey willow)-(*Coprosma tenuicaulis*) / raupo-*Gleichenia microphylla-Baumea teretifolia* / *Sphagnum* shrub-sedge-fern-reedland
* Manuka-harakeke-toetoe-raupo/*Baumea tenax-B. teretifolia-B. arthrophylla*-swamp kiokio sedge-shrubland
* Manuka-monoao / *Gahnia-Astelia grandis-Gleichenia dicarpa* / *Sphagnum* shrubland and scrub
* Manuka-*Coprosma tenuicaulis* scrub and shrubland
* Tanekaha / manuka scrub and shrubland
* Grey willow forest
* Manuka scrub and shrubland.

Geothermal

* Pohutukawa × northern rata dominant forest
* Prostrate kanuka-manuka-mingimingi scrub
* Mingimingi-prostrate kanuka-manuka scrub ⇔ *Histiopteris incisa* fernland ⇔ *Hypolepis distans* fernland

* Manuka-prostrate kanuka-*Lycopodiella cernua* shrubland
* *Histiopteris incisa*-mingimingi fernland
* *Lycopodiella cernua* fernland
* (Dead pohutukawa × northern rata)/wheki-kamahi-*Gahnia setifolia* treefernland
* Nonvegetated raw-soilfield

Others

* Lake
* Bluffs
* Landslide scars

Forests

The main forest type is rimu/tawa forest. Its composition varies according to changes in three main factors—distance from coast, altitude, and topography. A few tree species disappear with increasing distance from coast and altitude (for example: pohutukawa, puriri, and kohekohe) or tend to decrease in abundance. Others become more abundant with increasing altitude or distance from the coast, or are common only on certain sites (for example: pukatea, maire tawake).

Coastal

Pohutukawa is dominant on coastal cliffs, with scattered houpara and mahoe. On coastal hillslopes there are mixtures of pohutukawa, kanuka and rewarewa with kohekohe, puriri, tawa, mamaku, pukatea and whau in gullies. This forest cover has been induced through burning. Low scrub or shrubland of manuka, mingimingi and hukihuki occurs locally.

Semi-Coastal

The semi-coastal bioclimatic zone extends from 100–200 m asl up to about 500 m, inclusive of all the Rotoiti Breccia formation and the Papamoa Range, but continuing further west only as a comparatively narrow band across the lower fringes of the Mamaku and Whakamarama Plateaus. There is also a narrow strip along the lower face of the Okauia fault scarp and the south-western extremity of the Mamaku Plateau.

At the time of human occupation, the zone was entirely forested, but after centuries of Polynesians followed by Europeans, that cover has become extremely fragmented. The only sizeable remnants occur on the Papamoa Range, the Matata Hills, and the mid-southern section of the Rotoiti Breccia Fan. Because of logging, damage by fire, and grazing and browsing by introduced animals, nearly all remnants, large or small, have been modified to some degree.

The main forest type on the typical easy rolling to moderately hilly terrain, was dominated by scattered emergent rimu, miro, and northern rata, over frequent tawa, hinau, rewarewa, mangeao, pukatea, and kohekohe. Puriri and karaka, and even pohutukawa (in the Kaituna River catchment) occurred locally. Understorey species confined to this zone are nikau, mamaku and gully tree ferns, and the shrub kawakawa. Former forest on valley flats nearing the northern margins was distinguished by a predominance of kahikatea and pukatea, and presence of some

matai, totara, maire tawake, and probably, though unconfirmed, lowland ribbonwood.

A unique association of pohutukawa and hard beech still occurs on the most rugged portion of the Matata Hills. Kauri, whatever its past distribution, is still represented by one stand of stunted trees on an infertile site at the northern end of the Papamoa Range and a few rickers on the eastern flank, south-west of Te Puke. A few decades ago, kauri occurred near McLaren Falls near State Highway 29, but have been destroyed in a river flood.

Lowland

An also once complete forest cover was little disturbed in Polynesian times, but the greater part was exhaustively logged during the present century, up until about 1980. During this period, substantial areas were increasingly cleared for farming or exotic forestry, mainly in the eastern half of the Mamaku Plateau. The only substantial unaffected forest tracts are on the higher half of the Whakamarama Plateau (Kaimai Range) and the upper Opuiaki catchment of the Mamaku Plateau.

Again, the bulk of the forest consisted of one broad type. The common trees were rimu, northern rata, miro, with local Hall's totara and kahikatea, emergent over tawa, hinau and rewarewa, and kamahi and tawari, these last two most indicative of cooler climate and higher rainfall. Wheki was (and still is) the common tree fern and is generally abundant.

Rugged terrain is far more common on the plateaus than in the semi-coastal bioclimatic zone. As streams become deeply entrenched, Hall's totara, tanekaha, toatoa, kamahi, and tawari prevail, and toru and neinei occur in an understorey with few tree ferns but abundant sedges. Almost pure hard beech forest still occurs on all the very steep gorge sides in the lower reaches of the streams. An association of hard beech, red beech and silver beech about the upper reaches of the Mangorewa River incorporates all the elements of the above podocarp-broad-leaved type on similar terrain.

The originally quite extensive mixed beech-podocarp-hardwood type on apparently infertile flat to hummocky ground about the sources of the Mangapapa and Mangorewa Rivers was logged, with much subsequent clearance. However, an unmodified remnant fortuitously remains.

A few kauri occur not far within the confines of this zone: they are spaced along gorge or deep valley margins of the Omanawa and Mangapapa Rivers and the Rapurapu and Kakahu Streams. In the Mangapapa and Rapurapu localities, fire-induced scrub and secondary forest contains many kauri rickers and seedlings.

Stunted forest, with Hall's totara, kamahi, and broadleaf, caps the atypical prominences of Otanewainuku and Hiwiroa on the Mamaku Plateau.

Sub-Montane

"Goblin" forest on the Te Weraiti summit is dominated by tawari with common associates tawheowheo, orihou and *Dracophyllum traversii*. There is scattered puka, kaikawaka and kanono. (This is the only

occurrence of kaikawaka in the district, although it occurs commonly on sub-montane forest on the adjacent Te Aroha Ecological District to the north.)

Sand dunes

The original sand dune vegetation has been altered substantially in recent times. A railway line and state highway has been constructed at the base of the sandstone and breccia cliffs between Otamarakau and Matata. The vegetation between these and the sea is highly modified, with introduced grasses, herbs and shrubs including marram, catsear, harestail, pampas, *Eucalyptus botryoides* and African boxthorn growing in association with native species. Spinifex, marram and *Muehlenbeckia complexa* are common on the foredunes, with scattered pingao. *Ficinia nodosa* and *Muehlenbeckia complexa* are common on the rear dunes.

At the north-western end of the sand dunes a commercial mining operation extracts sand from the foreshore and dunes.

Wetlands

Very few wetlands remain in the district. Local dune hollow wetlands, generally small, occur along the coast. Common species include raupo, *Bolboschoenus fluviatilis*, pampas and harakeke. Several small wetlands occur in small gully flushes or associated with small streams on the eastern side of the district. The largest of these is the Tuhua wetland. Common species include raupo, waewae kaka, *Baumea* and *Coprosma tenuicaulis*. Wetlands have also been invaded by rapidly spreading adventive species, including grey willow, water purslane and mercer grass. Inland, on the Mamaku Plateau a little distance north of State Highway 5, is a series of natural wetlands and pakihi induced by logging. Common species include manuka, monoao, *Gleichenia dicarpa*, *Baumea teretifolia*, *Astelia grandis* and *Sphagnum*.

Forest modification and health

Whilst there are several relatively large good quality examples of unlogged forest in the district, all forest has been modified to varying degrees by the activities of browsing animals or the presence of introduced plants. Several of the larger unlogged forest tracts in protected natural areas are in relatively good condition. However, the majority of the extant forest tracts or remnants have been logged (see Vegetation History) or crown fires have passed through them. The intensity of logging varies. Some forests have been merely selectively logged for large podocarps, but many blocks have been logged more intensively (often two or three times) for tawa, hinau, rewarewa, kohekohe, mangeao, pukatea, red beech, puriri and all podocarps.

There are major tracts of logged podocarp-hardwood forest on the eastward fall of the Whakamarama Plateau. Podocarps have been eliminated and hardwood canopies disrupted by partial burning or incomplete clearing of podocarp-hardwood forest in places along the present western forest margin (as foothills were cleared many years ago for farming). A sizeable area of tawa-kamahi-tawari forest occurs between 550–650 m a.s.l. The

south-west quarter of the Whakamarama Plateau has not been logged but appears to be naturally almost devoid of emergent podocarps.

Many unprotected natural areas are grazed by domestic stock and smaller examples appear to have doubtful long-term viability if grazing continues at present levels. Adventive trees and shrubs are often locally abundant in these remnants, reflecting repeated disturbance (burning and clearing). Prominent species are radiata pine, patula pine, pinaster pine, gorse, and willow-leaved hakea.

There are several landslide scars below Te Weraiti, on the Kaimai Range. Jane & Green (1983a) proposed that natural vegetation mortality adjacent to this type of site is the most important factor predisposing the area to erosion. In their study no evidence was found to suggest that the mortality was due to browsing animals, but rather was linked to a severe drought in 1946. Prevalent fog, by maintaining high soil moisture content, may enhance vegetation susceptibility to drought and increase the landslide risk in the fog zone. From their work further north along the range, Jane and Green (1983a) found that severe storms in 1954, 1960, 1966 and 1972 followed a period of below-average storm intensity and triggered the current erosion episode. An earthquake in 1972 post-dated the main erosion episode and intensified erosion activity.

VEGETATION TYPES

Brief descriptions of the broad vegetation types identified during the survey are provided in Appendix 2.

FLORA

General

Around 500 indigenous species have been recorded in the ecological district over the last decade. A list has been compiled on the present survey, combined with other species lists compiled in the district (for example: McLaren Falls (Beadel 1994b), Lake Hiwiroa (Rotorua Botanical Society 1985a,b&c), Otawa-Otanewainuku (Beadel 1985a), Matata Scenic Reserve (Beadel 1991), see Bibliography for a full listing). A comprehensive list is provided in Appendix 3: this is not complete because of the rapid survey techniques used and the limited time available. Further survey will result in additional taxa being found, particularly in specialised habitats, such as wetlands and bluffs. Several species which were thought to be no longer present in the ecological district have been recently rediscovered in the ecological district (for example: *Peraxilla tetrapetala*, which was recorded more than 25 years ago). One hundred and ninety-nine adventive vascular species are listed in Appendix 4. However, these are only the prominent or common weeds, and the total adventive flora could be considerably greater.